

REMARKS

Applicant respectfully requests consideration of the present application in view of the foregoing amendments, the requests for continued examination and in view of the reasons which follow.

Claims 1-24 and 27-28 stand rejected in the Advisory Office Action dated January 29, 2003. Claims 1-12 have been amended. Claim 29 has been added. Accordingly, Claims 1-24 and 27-29 remain pending in the application.

In paragraphs 2 and 3 of the Final Office Action, claims 1-3 and 7-10 are rejected under 35 U.S.C. § 103 as being obvious over by U.S. Patent No. 5,591,653 (Sameshima). The Examiner states:

Sameshima et al. discloses a method of manufacturing an integrated circuit, comprising; providing an amorphous semiconductor material 3 including ... above a bulk substrate of single crystal semiconductor material 100 al. [and] providing a cap layer 6 before the doping step.

Applicant respectfully traverses the rejection. In particular, applicant respectfully traverses the Examiner's conclusions that Sameshima discloses or suggests a bulk substrate.

In paragraph 4 of the Final Office Action, Claims 1-24, 27 and 28 are rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,461,250 (Burghartz) in view of Sameshima. The Examiner states:

Burghartz et al. discloses a process of forming a transistor with a silicon germanium channel region, the process comprising; depositing a thin silicon germanium material above a top surface of a semiconductor substrate ... [and also] discloses forming silicide layers on the source and drain regions (see figure 4).

Applicant respectfully traverses the rejection. Burghartz and Sameshima are referred to below as the cited art.

With respect to claims 1-24 and 27-28, it is respectfully submitted that the combination of Sameshima and Burghartz would not cause one of ordinary skill in the

art to arrive at the present invention. Sameshima teaches an SOI substrate, which is conventional for thin film transistors. Substrate 1 of Sameshima is not a bulk substrate because it is manufactured of glass. Burghartz similarly builds its TFT on an insulator and only mentions the possibility of a silicon support substrate. Burghartz, column 6, lines 16-24. Even if a semiconductor support structure were utilized, the TFT would still be built on an insulative layer 114 that is necessary for gate insulation. Therefore, the cited art does not teach the bulk substrate of the present invention. Accordingly, it is respectfully submitted that Claims 1-24 and 27-28 are patentable over the cited art.

With respect to independent claim 27, the method dopes at least a portion of the bulk substrate to form the source and drain regions. Claim 27 recites:

doping the single crystalline layer and the substrate at a source location and a drain location to form a source region and a drain region....

Such a feature allows deep source and drain regions to be formed with sufficient depth for silicidation and yet achieve a thin channel region including germanium. See present application, page 9, lines 15-16.

The doping feature of claim 27 is not shown, described or suggested in the cited art. In Sameshima, semiconductor substrate capable of being doped for source and drain regions is not mentioned or suggested. Similarly, Burghartz does not discuss or suggest doping a bulk substrate. Indeed, with the preferred SOI architecture of the cited art, the bulk substrate doping would not be possible. Accordingly, it is respectfully submitted that Claim 27 and its dependent Claim 28 are additionally patentable over the cited art.

With respect to independent claim 1, dependent claim 11, dependent claim 28 and dependent claim 29, the depth of the silicide layer and/or the function of reducing the effects of germanium in the source regions is recited. Such a feature is described in the detailed description of the present application. The present application states:

Siliciding regions 22 and 24 to form regions 82 can consume the portion of regions 22 and 24 that includes germanium.... Thus,

the performance of regions 22 and 24 is not adversely impacted by
the presence of germanium.

See present application, page 7, lines 15-18. Thus, the features of Claims 1, 11, 28
and 29 provide significant advantages.

The features of Claims 1, 11, 28, and 29 are not shown, described or
suggested in the cited art. In Sameshima, silicide layers are not even mentioned, much
less the particular depth for the silicide with respect to another layer. Although
Burghartz discloses a silicide layer, there is no discussion of that layer being deeper
than layer 102. In fact, Burghartz does not even discuss a preferred thickness for the
silicide layers. See Burghartz, column 9, lines 33-36. Accordingly, it is respectfully
submitted that Claims 1, 11, 28, and 29 are additionally patentable over the
cited art.

Applicant believes that the present application is now in condition for
allowance. Favorable reconsideration of the application as amended is respectfully
requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that
a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

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FOLEY & LARDNER
777 East Wisconsin Avenue
Milwaukee, Wisconsin 53202-5367
Telephone: (414) 297-5768
Facsimile: (414) 297-4900

By Joseph N. Ziebert

Joseph N. Ziebert
Attorney for Applicant
Registration No. 35,421

MARKED UP VERSION

In The Claims:

1 1. (Twice Amended) A method of manufacturing an integrated circuit,
2 comprising:

3 providing an amorphous semiconductor material including germanium
4 above a bulk substrate of semiconductor material;

5 laser annealing the amorphous semiconductor material to form a single
6 crystalline semiconductor layer containing germanium; [and]

7 doping the single crystalline semiconductor layer and the substrate at a
8 source location and a drain location to form a source region and a drain region,
9 whereby a channel region between the source region and the drain region includes a
10 thin semiconductor germanium region; and

11 siliciding the source region and the drain region to form a silicide layer,
12 the silicide layer extending into the substrate.

13 11. (Thrice Amended) The method of claim 1, further comprising:

14 providing a second amorphous semiconductor material above the
15 amorphous semiconductor material including germanium [before] after the laser
16 annealing step, [wherein the] performing another laser annealing step [forms] to form a
17 second single crystalline semiconductive layer from the second amorphous
18 semiconductor material; and

19 wherein the siliciding step forms the silicide layer [the source region and
20 the drain region to form a silicided layer wherein] so that the depth of the silicided layer
21 is deeper than the second single crystalline semiconductor layer.

22 12. (Twice Amended) A method of manufacturing an ultra-large scale
23 integrated circuit including a transistor, the method comprising steps of:

24 depositing an amorphous silicon germanium material above a top surface
25 of a semiconductor substrate;

26 first annealing the amorphous silicon germanium material;

27 depositing an amorphous silicon material above the silicon germanium
28 material;

29 second annealing the amorphous silicon material; and
30 providing a source region and a drain region for the transistor, the source
31 region and the drain region being deeper than a combined thickness of the silicon
32 germanium material and the silicon material.
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